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84 Hair treatment preparation containing vinyl caprolactam/vinyl pyrrolidone/alkylacrylate polymer.

87 A hair conditioning composition comprising a polymer of vinyl pyrrolidone, dialkylaminoalkylmethacrylate monomers and a substantially major amount, based on said monomers of vinyl caprolactam monomer, said polymer optionally containing a minor amount, based on said monomers, of styaryl methacrylate monomer.

EFFECT OF VINYLCAPOROLACTAM CONTENT ON
COPOLYMER CLOUD TEMPERATURE

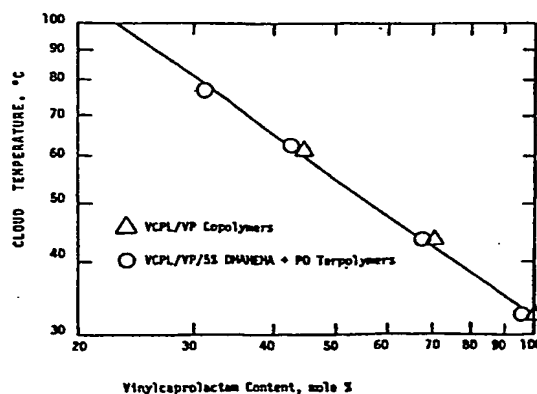


FIGURE 1

TITLE MODIFIED -1-

See front page

HAIR PREPARATION CONTAINING VINYL
CAPROLACTAM/VINYL PYRROLIDONE/ALKYL ACRYLATE
POLYMER.

This invention relates to terpolymers and to cosmetic preparations (especially hair setting and conditioning compositions) containing them.

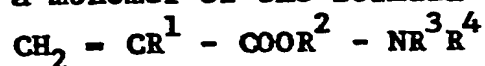
In the field of hair care, setting, waving, conditioning and the like, several broad types of hair treating preparations have been proposed, the principal ones being cationic surfactants, super-fattening materials, water soluble proteins and synthetic polymers, in a suitable cosmetically acceptable medium. The synthetic polymer-containing preparations are generally regarded as most effective, particularly those containing water soluble cationic polymers which are substantive to hair and exhaust thereon from solution or diluent medium. British Patent No. 1,331,819 and U.S. Patent Nos. 3,910,862, 3,914,403 and 3,954,960, the disclosures of which are incorporated herein for reasons which will become apparent, describe water soluble cationic quarternized copolymers of vinyl pyrrolidone (N-vinyl-2-pyrrolidone), hereafter referred to as VP and a dialkylaminoalkyl acrylate or methacrylate, which have been found to be highly effective in providing most of the properties considered necessary in the theoretically perfect hair preparation, as in fact also described in said patents. The hair preparations described in said patents are

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however not optimal in certain respects, notably
a high cost of producing the quarternized copolymers,
a curl retention which is not as good as could be
desired under high humidity conditions, and as an ease
5 of removability and/or resistance to build-up which
is also not as high as could be desired.

U.S. Patent No. 4,223,009 attempts to provide an
improved system through the use of a copolymer of
99.5 to 45.1 mole percent vinyl pyrrolidone, 0.5 to
10 4.9% of an acrylate and 0 to 50% of an ethylenically un-
saturated copolymerizable monomer such as the alkyl
vinyl ethers, e.g. the methyl, ethyl, octyl and lauryl
vinyl ethers; acrylic and methacrylic acid and esters
thereof, e.g. methyl acrylate, ethyl acrylate and
15 methyl methacrylate; vinyl aromatic monomers, e.g.
styrene and alpha-methyl styrene; vinyl acetate and
chloride; vinylidene chloride; acrylonitrile and
methacrylonitrile and substituted derivatives thereof;
acrylamide and methacrylamide and N-substituted
20 derivatives thereof; crotonic acid and esters thereof,
e.g. methyl and ethyl crotonate; and the like.

The patent broadly defines the acrylate as being
a monomer of the formula



25 wherein

R^1 is H or CH_3 ,

R^2 is C_{1-20} alkylene, and

R^3 and R^4 are independently C_{1-4} alkyl.

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U.S. Patent No. 4,223,009 further indicates that it was highly surprising to discover that elimination of the quarternization step required in accordance with the teachings of said patents not only did not result in any significant detriment to the properties of the hair preparations containing such polymers, but proved advantageous in substantially reducing the costs of manufacture and in providing hair preparations yielding improved properties in the treated hair with respect of improved curl retention under high humidity conditions, ease of removability and/or resistance to build-up with repeated use, among other miscellaneous advantages.

The shortcomings of the use of poly-N-vinyl-2-pyrrolidone (PVP) in hair conditioning formulations is expounded upon in U.S. Patent No. 3,145,147. According to the patent current popular aerosol hair spray composition contain as the hair setting and waving medium, poly-N-vinyl-pyrrolidone (PVP). When a PVP-alcohol solution is applied in an aerosol system to human hair under a relative humidity of less than 50%, the tendency of the resulting film to tackiness is minimal. As a result thereof, the preparation is acceptable by all consumers. However, when the relative humidity is above 50%, and particularly in humid atmospheres, films of PVP obtained by spraying from an aerosol system, pick up considerable moisture. The moisture is retained and results in a tacky film. In view of this property of moisture retention, these aerosol preparations are extremely undesirable where a dry hair condition is required as is the case with

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most users, especially women. The equilibrium water content of PVP depends upon the relative humidity of the atmosphere. The moisture content varies in a linear fashion with relative humidity, and the equilibrium percentage of moisture is about one-third of the relative humidity. Thus if PVP is exposed to a relative humidity of 50%, the moisture pick-up is approximately one-third of the relative humidity, and therefore the resulting film contain about 13-14% moisture. To overcome the unique hygroscopicity of PVP, it has been suggested in the cosmetic art to employ detackifying agents such as shellac, cellulose acetate-propionate, etc. The former yields films which become opaque at high humidities, and the latter yields films which are insoluble to ethyl alcohol. Carboxymethyl cellulose, cellulose acetate, methyl methacrylate polymer, polyvinyl formal, etc. are not effective as detackifiers under conditions of extremely high humidities.

Another drawback of PVP is that in the course of its manufacture and handling, the polymer picks up sufficient moisture (water from the atmosphere) to substantially modify its solubility in solvents, other than lower alcohols, such as acetone, methylene chloride, etc. and prohibits its use in formulation of aerosol propellant mixtures. However, storage of PVP at 50% relative humidity yields a material which possesses solubility at a 10% level in absolute ethanol but is not completely soluble in acetone and methylene chloride. One prime reason which rules out the use of PVP in the formulation of aerosol compositions for the application of films to surfaces other than hair is its insolubility

or rather insufficient solubility in acetone and methylene chloride. In the formulation of protective film coatings for surfaces such as silver and silver plate ware to protect them from tarnishing, etc., coupled with fast drying, a concentration of the film forming medium must be at least 5% and usually the preferred concentration being 10% and higher.

In order to provide a formulation which does not have the shortcoming of PVP systems, the 3,145,147 patent advocates the use of copolymers of N-vinyl- ϵ -caprolactam. The patent discloses that the copolymerizable compounds which may be copolymerized with N-vinyl- ϵ -caprolactam include vinyl esters such as vinyl acetate, vinyl isopropenyl acetate and the like; alkyl acrylates such as methyl acrylate, ethyl acrylate, methyl methacrylate and the like; acrylamides such as acrylamide, methacryamide and the like; acrylonitriles such as acrylonitrile, methacrylonitrile and the like; alkyl vinyl ethers such as methyl vinyl ether, ethyl vinyl ether, isopropenyl methyl vinyl ether and the like.

Generally, the above mentioned U.S. patent demonstrates the greater water sensitivity of vinyl pyrrolidone polymers over that of vinyl caprolactam polymers.

The present invention provides a hair conditioning composition consisting of or containing a terpolymer derived from vinyl pyrrolidone monomer, an ammonium derivative monomer and a substantially major amount based on said monomers of vinyl caprolactam. The polymeric composition may optionally contain a minor amount of stearyl methacrylate. Suitable ammonium

derivative monomers include dimethylamino propyl methacrylamide, dimethyl diallyl ammonium chloride and a dialkylamino alkyl methacrylate, such as for example dimethylamino ethyl methacrylate. It has
5 been found that copolymer made from the above monomers can be used to produce surprisingly high quality, low cost hair conditioning products.

Preparation of the terpolymer from the three monomers can be performed by conventional techniques
10 used for polymerising these monomers.

We have found that polyvinyl caprolactam and polyvinyl pyrrolidone display a surprising synergistic behaviour in withstanding high humidity holding failure. This has been established by testing hair samples
15 treated with instant terpolymer at 90% relative humidity at 80°F (27°C).

Polyvinyl pyrrolidone is known to be a very hydroscopic resin; whereas polyvinyl caprolactam is much less so. The hydroscopicity of the former resin
20 causes failure to retain hair curl under high humidity conditions. The polyvinyl caprolactam, being substantially less hydroscopic retains hair curl under these conditions. Thus, it was completely unexpected, that partial replacement of vinyl caprolactam (VCPL) by
25 vinyl pyrrolidone (VP) results in an improvement in high humidity holding. In fact, this effect increases as the VP was increased. However, the amount of VP incorporation is limited by the tackiness of the resin which occurred when significantly more than 25% by
30 weight of the final polymer was vinylpyrrolidone.

Another critical parameter is dependent upon resin build-up on the hair. In order to effect removal of the copolymer during shampooing usually at about 100°F (38°C) - it is very desirable to change the characteristics of polyvinyl caprolactam which becomes insoluble in water above 30°C. (86°F.). Unexpectedly, the incorporation of dimethylaminoethyl methacrylate did not change the cloud-clear point (temperature at which the resin loses solubility).

However, replacement of vinyl caprolactam by vinyl pyrrolidone does afford a significant change in cloud-clear point, and hence an improvement in shampooability.

Comparative trials were undertaken, as follows.

Poly vinyl caprolactam (PVCPL) homopolymer was compared with polyvinyl pyrrolidone (PVP), poly vinyl pyrrolidone/vinyl acetate (VP/VA), VP/VA Itaconic Acid and a commercially available material sold by GAF Corporation under the registered trademark GANTREZ, and designated as GANTREZ ES225 which is the ethyl monoester of poly (methyl vinyl ether/maleic acid) of 50% solids in ethanol. The formulations were used in anhydrous type hydrocarbon propelled hair spray formulations and compared for spray pattern, compatibility, hair characteristics and humidity holding. The PVCPL was found to be comparable to GANTREZ ES255, which is generally recognized as being a superior quality product. The PVCPL was superior to the other 5 resins tested.

Four vinyl caprolactam (VCPL) copolymers were compared with a PVCPL control, with the following results:

a) VCPL/Stearyl Methacrylate (97/3) -

Hair Tress humidity holding was significantly less than the control. On hair tress characteristics this polymer showed a little better ease of combing compared to the control.

b) VCPL/Methyl Methacrylate (95/5) -

This polymer was inferior in hair tress humidity holding and showed no advantages in hair tress characteristics when compared to the control.

c) VCPL/Dimethylamino ethyl methacrylate (95/5) quarternized with Propylene Oxide (PO) -

This polymer was significantly superior to the control in hair tress humidity holding. In hair tress characteristics, it gave very difficult combing attributes. Since this polymer is cationic it was further evaluated in a hydroalcoholic hydrocarbon system. Whereas the concentrate was clear, the charged unit was hazy. A hair tress humidity hold showed it held significantly better than the control. It was not compared to the anhydrous VCPL/Dimethylamino ethyl methacrylate system. A pyrazol red test on albino hair gave a light pink indicating some cationic material is retained on the hair.

d) VCPL/Acrylic Acid -

This polymer showed slight hazing in the concentrate and definite clouding in the charged unit when formulated unneutralized. Evaluation of 25%, 50%, 75% and 100% stoichiometric

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neutralizations showed the 100% gave a clear finished product. This formulation was evaluated and was inferior in hair tress humidity holding and offered no advantages in hair tress characteristics.

5

The outstanding result from these evaluations is the substantial increase in holding with only 5% dimethylamino ethyl methacrylate (DMAEMA) + propylene oxide (PO). In addition, the small amount of stearyl methacrylate (SMA) did appear to be helping the ease of combing, as would be expected. It was also noted that the compability of the quarternized DMAEMA copolymer was decreased.

10

Several additional sets of resins were then prepared and evaluated in anhydrous alcoholic systems, with the following compositional variables being explored:

15

- a) Low levels of long chain alkyl groups for expected improved compatability (quarternization of the DMAEMA with a C-16 epoxide or glycidyl dodecyl ether, as 92/5/3 VCPL/DMAEMA + PO/SMA).
- b) DMAEMA level.
- c) Effect of not quarternizing.
- d) Replacing some of the VCPL with VP.

20

25

A group of eight resins was selected for evaluation in both anhydrous and hydroalcoholic aerosols. Compatibility data for these resins are shown in Table I, where it is apparent that replacement of a small amount of VCPL with SMA gives a significant improvement. VCPL/SMA/DMAEMA + PO (92/3/5) was the only resin whose concentrate, anhydrous and hydroalcoholic aerosols were all clear, and it gave the best cloud/clear point in the hydroalcoholic system.

- 10 The hair tress humidity hold studies indicated the following:
- a) Quarternization is of no value in either system.
 - b) DMAEMA improves holding in both systems, and in the hydroalcoholic system. The DMAEMA level (2.5 to 10%) correlated well with the degree of holding.
 - c) All resins hold better in the hydroalcoholic system.

15 With regard to hair tress characteristics, all the test resins gave less comb residue than GANTREZ ES-225 but gave more comb drag and left the hair feeling more coated and tacky, although

20 a preliminary study with cast films indicated two of the test resins as being less tacky than GANTREZ ES-225.

TABLE I
COMPATIBILITY OF SELECTED VINYL CAPROLACTAM POLYMERS IN AEROSOL HAIRSPRAY SYSTEMS

Polymer Composition	Super Concentrate ^a	Alcoholic Aerosol		Hydroalcoholic Aerosol	
		Visual	Cloud/Clear Point ^b	Visual	Cloud/Clear Point ^b
VCPL	Hazy	Sl. Hazy	<-20°F	Clear	18°F/26°F
VCPL/DMAEMA (95/5)	V. Sl. Hazy	V. Sl. Hazy	<-20°F	Clear	16°F/20°F
VCPL/DMAEMA + PO (97.5/2.5)	Clear	Hazy	--	Hazy	--
VCPL/DMAEMA + PO (95/5)	Clear	Hazy	--	Very Cloudy	--
VCPL/DMAEMA + PO (90/10)	Very Cloudy	Cloudy, ppt.	--	Cloudy, ppt.	--
VCPL/VP/DMAEMA + PO (71/24/5)	Clear	Very Hazy	--	Cloudy	--
VCPL/SMA/DMAEMA + PO (92/3/5)	Clear	Clear	<-20°F	Clear	10°F/12°F
VCPL/VP/DMAEMA + C-16 Epoxide (71/24/5)	V. Sl. Hazy	Hazy	--	Hazy	--

^a3.75% solids in anhydrous ethanol. Concentrate is filtered before dilution to hydroalcoholic (8% water) or alcoholic aerosols (25% hydrocarbon propellant.)

^bCloud/clear points were not on hazy products.

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TABLE II
CLOUD TEMPERATURES OF VINYL CAPROLACTAM COPOLYMERS

<u>Copolymer Composition, mole %</u>			<u>Cloud Temperature^a</u>
<u>VP</u>	<u>VCPL</u>	<u>DMAEMA + PO</u>	
0	100	0	32.3°C
29.5	70.5	0	43.5
55.6	44.4	0	61.5
79	21	0	>100
0	95.5	4.5	32.5
27.9	67.6	4.5	43.4
52.9	42.6	4.5	62.4
75.3	20.2	4.5	>100
85.6	9.9	4.5	>100

^a Determined by diluting a 40% solution in ethanol with water to 5% and slowly heating with stirring on a hot plate until the polymer precipitated.

Series of VCPL/VP copolymers and VCPL/VP/5% DMAEMA + PO terpolymers were prepared for determination of their cloud temperatures (i.e., the temperature above which they precipitate from aqueous solution), with the thought that increasing the hydrophilicity of the resin should improve its shampooability. These data are shown in Table II, and when the cloud temperatures are plotted against VCPL content of the copolymers, they fall on a common line showing an inverse correlation in a log-log plot with an extrapolated 100°C cloud temperature at about 23 mole per cent VCPL, as shown in Figure 1. It can be seen that incorporation of DMAEMA into VCPL did not increase the cloud temperature to any appreciable extent, but incorporation of VP did do so.

All of the resins under evaluation had a 2.5% solids content which is the optimum level for the GANTREZ ES-225 resin. The high comb drag and "coated" feel of the hair observed with the VCPL resins was determined to attribute to the unnecessarily high level of VCPL and could be avoided through the use of decreased VCPL. Surprisingly, the VCPL exhibits a substantially better humidity holding power than GANTREZ ES-225 on an equal weight basis, and therefore, can be used at a decreased weight level without adversely affecting its humidity holding power.

Two series of unquarternized resins were evaluated at a 1.5% solids concentration level. In one series, VP levels were varied from 48 to 95% for improved shampooability and in the other series, VP and VCPL contents were equal, but DMAEMA levels were varied from 1% to 10%. The results were as follows:

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- 5 a) All VCPL resins at 1.5% were equal to or better than GANTREZ ES-225 at 2.5% on humidity holding.
- b) All left less residue on the hair and comb than GANTREZ ES-225.
- c) They all shampooed well, indicating that earlier observed shampooability problems were an artifact of overdosing and/or hair preparation technique.
- 10 d) Higher VP levels improved humidity holding.
- e) Higher VP levels increased the tack.

To test hair curl humidity holding, hair tresses were treated with the various polymers at the 1.5% solids level in hydroalcoholic and anhydrous alcoholic systems. They were dried under ambient conditions and the height of curl above a reference point measured. The tresses were exposed to 90% relative humidity (R.H.) at 80°F (27°C) and the height of curl measured again after the elapse of various periods. The height which remains is expressed as a percentage of the original height.

15

20

Some significant results, showing the percentage curl retention after 45 minutes are shown in Table III.

TABLE III

Polymer Composition VP/VCPL/DMAEMA	VP/VCPL Ratio	% curl retention *	
		hydroalcoholic system	anhydrous alcoholic system
0/95/5	0/100	63	64
19/76/5	20/80	78	81
47.5/47.5/5	50/50	89	90

* % curl retention measured after 45 minutes
at 90% relative humidity, 80°F (27°C).

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It was entirely contrary to expectation that going from 95/5 VCPL/DMAEMA polymer to 47.5/47.5/5 VP/VCPL/DMAEMA terpolymer would improve the resistance to high humidity holding fade.

5 A tack test was designed where the product is sprayed on a glass plate, dried thoroughly, and then the plate is conditioned under constant temperature and humidity. Three cotton balls are gently laid on the film. At 20, 40 and 60 minutes, one of the
10 balls is finger pressed onto the film and then removed. The amount of cotton left on the film is indication of tackiness. The butyl monoester of poly (methyl vinyl ether/maleic anhydride) of 50% solids in ethanol (GANTREZ ES-425) and the ethyl monoester of
15 poly (methyl vinyl ether/maleic acid) of 50% solids in ethanol (GANTREZ ES-225) as well as PVP K-30, were used as controls. All of the above N-vinyl caprolactam polymers showed tackiness quite similar to PVP K-30. However, by increasing the VCPL content to 71%, the
20 system was equivalent to GANTREZ ES-425.

Two samples were evaluated for tackiness properties according to Materials Research and Testing No. 82/01:

"Tackiness Test for Solvent Based Films".

25 Films of each resin were cast on a glass plate, dried and placed in environmental chamber. The humidity therein was gradually increased to the point when bead travel distance was interrupted due to tackiness of the film.

30 A sample of VP/VPCL/DMAEMA terpolymer, in proportions 47.5/47.5/5.0, and having a K value of 46.1 became tacky at 96% R.H. and 80°F (27°C). The bead travel

averaged 86 mm.

A sample in which the VP/VPCL/DMAEMA proportions were 21/74/5, having a K value of 40.8 remained dry. The shot bead rolled the entire length of the glass plate.

Touching the films with a finger also indicated the increased amount of tack of the first sample when compared with the non-tacky second sample.

Another set of three resins, in which some of the VCPL was replaced with lauryl methacrylate (5%), stearyl methacrylate (5%), and vinyl acetate (10%), was prepared to determine the possible beneficial effect of including a more hydrophobic monomer but no substantial differences were noted.

The foregoing testing showed that VCPL/VP/DMAEMA in a 71/24/5 ratio gave optimum results and was equivalent to about twice the concentration of a GANTREZ resin.

DMAEMA is known to be a more reactive monomer than VP and therefore, the use of a monomer feed reaction would be expected to yield a more uniform copolymer than obtainable in a batch reactor.

The only differences noted were in the 71/24/5 composition, where the monomer feed gave resin with somewhat inferior humidity holding - one slightly so in the anhydrous system but more significantly in the hydroalcoholic one. The effect of molecular weight was also examined for a threshold molecular weight for optimum holding. Evaluation of these tests showed a high molecular weight to improve holding in the anhydrous system.

The foregoing tests showed a polymer produced from 71/24/5 ratio of VCPL/VP/DMAEMA monomers to produce a hairspray resin at least equal in quality to the best resins in commercial use, such as GANTREZ 425 and 225, while requiring approximately half the concentration level of the commercial systems.

The low cloud temperature of the 71/24/5 VCPL/VP/DMAEMA resin would be expected to render the resin unsuitable for use in hair conditioning resins for shampoo.

However, in a creme rinse formulation and an anionic shampoo, the cloud point of the same resin was found to be 50° and 70°C respectively. The creme rinse formulation is as follows:

15	Triton X400 (stearyl dimethyl benzyl ammonium chloride)	7.0
	Glyceryl monostearate	2.0
	Cerophyl ²⁸ (cetyl lactate)	1.0
	Gluteraldehyde (25%)	.4
20	Sodium hydroxide (10%)	.26
	VCPL/VP/DMAEMA (38.12% solids)	1.05

H₂O (distilled) s to 100

An Amphoteric shampoo formulation is as follows:

25		<u> %</u>
	Gafac RS-610 (free acid of a complexed phosphate ester)	6.00
	Miranol cm conc. (N.P.)	
30	(dicarboxylic coconut derivative of an imidazoline, sodium salt)	25.00

	Distilled water	58.03
	10% citric acid solu.	7.00
	PEG 6000 distearate	
	(polyethylene glycol of	
5	MW 6000)	1.00
	Sodium sulfite	.10
	perfume	.25
	VCPL/VP/DMAEMA	2.62

The anionic shampoo formulation is as follows:

10	Distilled H ₂ O	53.58
	Sipon LT.6 (TEALS)	
	(triethanolamine lauryl	
	sulfate)	35.00
	Monamid CMA (cocomut	
15	monoethanolamide)	3.00
	Cocomut fatty acid	2.00
	Triethanolamine	1.40
	PEG 6000 distearate	
	(polyethylene glycol of	
20	MW 6000)	1.40
	NaCl	.60
	Sodium Sulfite	.10
	perfume	.30
	VCPL/VP/DMAEMA	2.62

25 A clear creme rinse formulation is as follows:

	Distilled water	95.08
	Natrosol 250 HHR	
	(hydroxyethyl cellulose)	.40
	Ammonyx KP (oleyl dimethyl	
30	benzyl ammonium chloride)	4.00
	VCPL/VP/DMAEMA	.52

The foregoing formulations were comparable to those using a resin sold under the registered trademark GAFQUAT and designated as GAFQUAT 755^N (the polymer of VP/DMAEMA of 20% solids in aqueous solution) with respect to substantivity, curl retention, build-up and build-up removal, but inferior in ease of wet combing.

The VCPL/VP/DMAEMA resin is free of carboxylic acid groups and accordingly should be less liable to corrosion problems of the type which would be encountered with a formulation of the type disclosed in U.S. Patent No. 4,164,562 when used with the hydroalcohol solvents of the patent.

The caprolactam-vinyl pyrrolidone ratio controls the water sensitivity of the product. Increased pyrrolidone concentrations increases the solubility of the caprolactam which becomes insoluble at temperatures greater than 30°C but increases the propensity toward tackiness at high humidity.

The third component is employed to provide substantiability, that is, the ability to adhere to hair, or other natural substances which are characteristically negatively charged.

Although polymer of the instant invention has, as its primary function, the contribution of humidity holding to the formulation, other properties can be improved through the use of other additives or comonomer. For example, stearyl methacrylate can be used in small quantities as a co-monomer in order to improve the combing characteristics without adversely influencing the humidity holding properties.

CLAIMS:

1. A hair conditioning composition consisting of or containing a terpolymer derived from a major proportion of vinyl caprolactam monomer and minor proportions of vinyl pyrrolidone monomer and an ammonium derivative monomer.
5
2. The hair conditioning composition of claim 1 wherein the ammonium derivative monomer is a dialkylamino alkyl acrylate or methacrylate.
3. The hair conditioning composition of claim 2
10 wherein the ammonium derivative monomer is dimethylamino ethyl methacrylate.
4. The hair conditioning composition of claim 3 wherein the proportion of dimethylamino ethyl methacrylate is 5 to 10 weight percent of the polymer.
- 15 5. The hair conditioning composition of any preceding claim wherein the proportion of vinyl caprolactam is at least 65 weight percent of the terpolymer and the proportion of vinyl pyrrolidone is not more than 25 weight percent of the terpolymer.
- 20 6. The hair conditioning composition of any preceding claim wherein the terpolymer also contains a minor amount of stearyl methacrylate.
7. The hair conditioning composition of claim 3
25 wherein the weight ratio of vinyl caprolactam to vinyl pyrrolidone to dimethylamino ethyl methacrylate is a ratio of about 70:25:5.

8. The hair conditioning composition of claim 7 wherein about 3% by weight of the vinyl caprolactam is replaced with stearyl methacrylate.

5 9. The hair conditioning composition of any preceding claim wherein the composition contains a surfactant.

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FIGURE 1

EFFECT OF VINYLCAPROLACTAM CONTENT ON
COPOLYMER CLOUD TEMPERATURE

